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Review of the Design-Build Market in the People's Republic of China

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Abstract:

Design-build (DB) system has been demonstrated as an effective delivery method and been widely used overseas. However it does not receive the same popularity in the People's Republic of China (PRC). This paper first conducts a literature review on advantages and disadvantages of DB in general; then it gives an overview of the PRC construction industry. There are ample evidences that the DB system will theoretically bring benefits to the PRC construction industry. After a thorough investigation of the current DB market, it can be concluded that the development of the DB system is still at its infancy stage. The barriers to entry have been finally identified, which relate to the legal restraints, negative owner attitude, and high requirement of DB projects. These barriers constitute obstacles to the development of DB system in the PRC. However, with rapid growth of construction industry, new requirements in modern construction projects, and strong promotion from governments, it is believed that the domestic DB market will have great potential in the near future.

Key words: design-build; construction market; barrier to entry; China

INTRODUCTION

Design-build (DB) is a delivery method in which the design-builder is contractually responsible for both design and construction work. It has been demonstrated as an effective delivery method and gained its popularity overseas (Konchar and Sanvido 1998). However, it does not receive the same popularity in the construction industry of the PRC, which is dominated by the traditional design-bid-build procurement system. By now, only less than 10 percent of the construction projects are delivered in DB method (China Construction Industry Association, "CCIA", 2006).

Despite the sharp contrast between the domestic and international DB markets, broad consensus on advantages of DB system has been reached among owners and government officials. It is believed that the DB market will have great potential given the prosperous construction industry and strong promotion from the government. However, considering the fact that it has yet to be adopted widely in the PRC, it is timely to investigate the suitability of this system. Design-build provides many advantages and is undoubtedly a popular choice in the recent times worldwide, but it does not necessarily mean that it would bring benefits to the construction industry of the PRC. Therefore, an appropriate review of the DB market in the PRC and a close examination of the suitability of this delivery system are urgently required.

In addition, the lack of a comprehensive review of the DB market in the PRC also prompts more in-depth studies in this area. Various researchers and organizations overseas have already undertaken a great deal of research on various aspects of DB field such as the selection of DB system (Molenaar and Songer 1997, 1998), frameworks of

DB success criteria (Chan et al, 2001, 2002), and design-builder selection procedures (Kumaraswamy 2000;Molenaar and Gransberg 2001; Singn and Tiong, 2005); however, there are few, if any, systematic studies focusing on DB field in the PRC.

Therefore, this paper conducts a comprehensive review of the DB market in the PRC. It mainly aims to (1) investigate the suitability of DB system in the construction market of the PRC, and (2) explore the possible reasons why DB system is not yet popular whilst in theory it should be beneficial. This paper will, hopefully, provide a solid platform to conduct further studies of DB system, and promote its application in the construction market of the PRC.

RESEARCH METHODS

This paper first conducts a literature review on advantages and disadvantages of DB system in general; then it gives an overview of the PRC construction industry. Since there are ample evidences that the DB system can serve as an effective solution to many problems in the construction market, it will theoretically bring benefits to the PRC construction industry. To verify this hypothesis, a comprehensive review of the DB market in the PRC is therefore conducted. The results indicate that the DB system is not popular in the PRC construction industry yet whilst in theory it should be. After the analysis of generic barriers to entry and the unique characteristics of the PRC construction industry, this paper has finally identified several promising reasons explaining the unpopularity of DB system in the PRC construction industry in today's market.

In order to have a whole picture of the DB market in China, this paper investigates the PRC construction industry, the current DB market, and the involvement of overseas contractors in the domestic DB market. The data are mainly taken from following sources:

--*National Bureau of Statistics of China*

--*Ministry of Construction of the People's Republic of China*

--*Ministry of Commerce of the People's Republic of China*

--*China Federation of Project Engineering Management*

--*China Construction Industry Association*

--*China Exploration & Design Association*

--*China International Contractors Association*

--*Engineering News Record*

In addition, some other materials will be obtained or validated through estimation, data mining and comparison with different sources.

LITERATURE REVIEW

The DB system has accounted for an increasing proportion of the construction market worldwide. As a procurement method, it offers much strength or advantages such as single-point responsibility, time saving, enhanced financial certainty, improved buildability, reduced disputes and increased productivity.

With a single-point contract, the owner can allocate all design responsibility to the contractor and concentrate on project definition. The owner's administrative burden will

be, in turn, greatly reduced. Although the owners are still required to oversee the design and construction process, this responsibility is less time consuming. Being the single party responsible for design and construction work, the design-builder can have a better control over the project. Many researchers (Song and Molenaar 1997; 1998; Mo and Ng, 1997; Pearson and Skues, 1999; Leung, 1999) have proposed that if DB projects are under control of experienced DB contractors, it will probably lead to the success of DB projects.

Design-build is considered to be the fastest project delivery system. Konchar and Sanvido (1998)'s empirical research indicates that the delivery speed of DB is faster than that of construction management and traditional design-bid-build system in the U.S. This is mainly because, firstly, DB system encourages the overlapping of design and construction process, which reduce the delivery schedule. Secondly, the buildability of the design work will be greatly increased due to the early input of construction knowledge to the design process and the close communication among project participants (Songer and Molenaar, 1997). In addition, the earlier completion of the project will also provide the owner with earlier use of the facility.

The DB system will secure the certainty of project cost and schedule at early stage. The DB contract is usually awarded on a lump-sum basis, which will provide the owner with early estimation of project cost. By allowing only one entity the total control over design, scope and budget, DB method offers a higher possibility of completing the project within budget and schedule. Additionally, an improved communication between design team and design-builder reduces possible design changes, which may lead to construction changes and eventually project delay.

In addition to the advantages identified above, there are other benefits derived from the DB system. The shortening of project duration, close relationship between the designer and contractor, and better constructability will lead to cost reduction (Songer and Molenaar, 1997). The singular responsibility will motivate the design-builder to foster creative design and construction solutions, which will, in turn, improve the constructability. The single-point responsibility of the design-builder will also reduce claims and litigations. Even if the owner may lose the direct control over the project quality, there is no apparent reason for the construction quality in DB to be lower than with the traditional approach (Ndekugri and Turner, 1994)

The main disadvantage of this system is that the owner's interests and requirements may not be fully satisfied. With the same firm designing and building the project, there may not be an independent party providing the necessary service to protect the owner. In addition, the owner has to prepare sufficient specifications and clear project definition for the bidding job. Otherwise, it can be very costly if the information provided by the owner to the contractor is inaccurate at the outset of the DB process (Mogaibel, 1999). The DB system may also limit the bidding competitiveness given the condition that many of the DB contracts are negotiated at early stage of projects.

OVERVIEW OF THE PRC CONSTRUCTION INDUSTRY

The construction industry in the PRC has developed rapidly in recent years, and it has become a pillar industry of the national economy. In 2006, the construction industry represents about 5.6% of its GDP. Table 1 shows the added value of the construction

industry from year 2000 to 2006. Considering the rapid and continuous growth, the construction industry will have great potential and larger market capacity. It is estimated that the added value of construction industry will come up to more than USD200 billion, which will make up 7 percent of the GDP by year 2010.

Table <1> about here

However, the construction industry is at low concentration rate. According to *Engineering News Report* and *Construction Times (*2006*),* the domestic turnover of the top ten Chinese contractors is $40.323 billion, which only makes up about 10 percent of the total output of the construction industry. According to Bain (1968)'s analysis of concentration ratio (CR), the construction industry has a very competitive market structure. In 2006, there are over 60,000 construction firms completing in the construction market. Most of them have medium to small scales, and only engage in the labor-intensive construction work. The low market concentration and the large number of companies lead to fierce competition and low profitability of the construction industry. In 2006, the total profit of the construction enterprises takes up only 2.9 percent of the product value; the ratio of liability to assets is as high as 65 percent. Many of the stronger or larger scale firms, therefore, intend to explore the DB market because DB projects generally offer higher profit margins to DB contractors.

In the PRC construction industry, over-schedule and over-budget have presented the most serious problems, in particular to the public sector owners. It is estimated that most of the public-investment projects are over-budget by 20-30 percent. This is mainly because many project owners are state-owned organizations who have no responsibility for the overruns of budgets and construction time. With the government transferring its

planned economic system into a market-oriented economic system, new procurement methods have been introduced to overcome these problems. The DB system, in particular, has been strongly promoted by the government because of its obvious advantages and popularity overseas.

It is believed that the DB system will bring benefits to the PRC construction industry. The advantages of DB system such as single-point responsibility, shortening duration time, leading contractors to keep on technological upgrading can provide solutions to many problems, which now exist in the construction market of the PRC. The DB system is the return of the old "Mater Builder" concept, and regains its popularity when the traditional design-bid-build system no longer fit for the inflationary 1970s and the litigious 1980s (Songer and Molenaar, 1997). It in particular has experienced extraordinary growth in recent years overseas. Consensus on the effectiveness of DB system has been reached among many owners and government officials. Many key projects have been successfully delivered in this method. It is anticipated that the DB system will be widely used in the construction market of the PRC in the future.

REVIEW OF DESIGN-BUILD MARKET IN THE PRC

Definition and Scope of Design-build System in the P.R.C

In the People's Republic of China, DB system is defined as "one type of the general contracting system under which the contractor performs both design and construction practices and take full responsibilities of project quality, safety, schedule, and cost under one single contract" (Ministry of Construction of the P.R.CHINA, 2003[30]). Among other general contracting systems are Engineering-Procurement-Construction

(EPC), Engineering-Procurement (EP) and Procurement-Construction (PC). In this definition, the DB system is different from EPC/Turnkey in which the contractor is responsible for design, procurement, construction, commissioning and operation. However, most of the statistics, published or disseminated in the PRC, have not differentiated between them. More importantly, they share the most essential element that the contractor takes full responsibilities of design and construction under one single contract. Therefore, the DB system in this paper basically refers to the general contracting system, which includes both DB and the DB plus.

The Design-Build Market in the PRC

In the PRC, the DB delivery system was first introduced into the Petroleum and Chemistry industry in the 1980s and than spread to the metallurgical industry, electronic industry, infrastructure construction, and housing industry. There are now over 200 construction enterprises conducting DB business. It is estimated that there are about 30 percent of the projects are suitable or partially suitable for the DB contract (CCIA, 2006).

DB contractors have made sound progress in the DB market in recent years. According to the statistics of Chinese top 60 Contractors (*ENR & Construction Times*, 2003-2005), the DB contract value of the top 60 contractors are $6.6 billion, $8.5 billion and $10.4 billion in year 2003, 2004 and 2005 respectively. Particularly, in year 2005, there were 46 Chinese contractors on the list of the top 225 international contractors, and 12 of them were among the top 100. Meanwhile, the DB contract values of the top 100 design consulting companies are $4.55 billion, $6.57 billion and $9.40 billion in 2003, 2004

and 2005 respectively according to the statistics conducted by China Exploration & Design Association. Table 2 shows the DB contract value of the top 60 contractors and the top 100 design consultants from 2003 to 2005.

Table <2> about here

Although the DB delivery system developed rapidly in the PRC, only 10 percent of the construction projects are delivered in DB system this far (CCIA, 2006). The total value of the DB contract, undertaken by the top 100 design consultants and the top 60 contractors, takes up less than 5 percent of the total output of the construction industry. The DB system develops unevenly in different industries. It is estimated that there are only 5-10 percent of DB projects in the housing & communication industry, while 15-20 percent in the metallurgical industry, chemical industry, and metallurgical industry. The operational ways of DB system also vary in different industries. In the petrochemical, metallurgical and electronic fields, more than 50 percent of the DB projects are delivered in EPC method because of the necessity for one entity to take control over the design, construction, procurement and commissioning. While in the housing industry, most of the DB projects are delivered in the way of developed-and-construct method in which the owner entails the design consultants to develop most of the design work before engaging the design-builder to complete the remaining detailed-design and construction work.

In addition, the DB contract values of the top 100 design consultants vary greatly in different industries. For example, the metallurgical industry and the petrochemical industry have much larger DB contract values than those of housing industry, communication industry and municipal construct field. The DB contract values of the top five industries make up more than 75 percent of the total sum of the DB contract

values. The description of DB contract values in the top 5 industries is demonstrated in Table3.

Table <3> about here

Fig 1 specifically illustrates the ratios of the DB contract values in different industries to the total sum in 2004:

Fig <1> about here

Foreign Contractors in the DB Market of the PRC

With China's open-up policy since 1980s, many foreign contractors have entered into the PRC construction market. Meanwhile, a large number of foreign-invested construction companies have been established in the PRC, especially after China's accession to the WTO in 2001. At the end of year 2000, 136 foreign enterprises from 15 countries or regions obtained the qualification certificates issued by Ministry of Construction and local construction administrative department. Among them, 69 enterprises come from Hong Kong followed by 18 enterprises from Japan (Fig 2). At the end of October 2006, fives years after China's accession to the WTO, 1189 foreign-invested construction companies and 223 foreign-invested design companies have been registered in the PRC. Among the total 1412 foreign-invested companies, more than 700 are wholly foreign-owned or foreign-controlled.

Fig <2> about here

Hong Kong has the largest numbers of both construction and design companies that have been registered in the PRC. The contract values of these companies, however, are relatively small. Most of their businesses focus on decorative engineering and equipment installation. Although there are fewer American and European contractors, most of them are world-class contractors, and engage mainly in the DB and project management fields. In general, foreign contractors operate higher proportion of DB business than Chinese contractors. According to the statistics collected by the Ministry of Construction of the PRC, the DB contract value of foreign contractors was $1.49 billion and makes up nearly one third of their total contract value ($4.53 billion) from year 1998 to 1999 (Fig 3). In 2005, the contract value of the American and Singaporean contractors is $1.8 billion and $1 billion respectively, and most of the projects are delivered in the DB system.

Fig <3> about here

DISSCUSSION: DB MARKET BARRIER TO ENTRY IN THE PRC

After the investigation of the DB market in the PRC, it can be seen that the DB system has not been widely used yet. In exploring potential reasons attributing to this situation, the theory of barrier to entry provides an insightful perspective to analyze the DB market. The barrier to entry is an important characteristic of an industry. It is suggested, in industrial economics, that barriers to entry are resulted from absolute cost advantages, economics of scale, product differentiation, the degree of firm concentration, and market risk (Bain, 1956; Mann, 1966; Baldwin *et al.,* 1995). After the analysis of generic barriers to entry and the unique characteristics of the PRC construction industry, the DB market barriers to entry have been identified as follows:

Restraints of the legal system

Up to now, there have been no specific laws or ordinances on the DB delivery system. The existing laws including the *construction law, tendering law* and *Construction Quality Management Ordinance* only have regulations on exploration, design, construction, and construction supervision. Because of the lack of tendering procedure, licensing regulations, and standard contract forms for the DB system in the PRC construction market, many local governments that generally lack the experience in administrating this new system, do not favor the DB method.

The DB method may also give rise to conflicts with competitive bidding laws. Projects in the public sectors usually require a competitive process to choose a contractor, and some local statutes and regulations even absolutely require a competitive bidding on the basis of price. The price-oriented process of contractor selection may prevent the owner obtaining the best value of the DB projects. To some DB projects, it may be more appropriate to negotiate with potential contractors at the early stage to encourage the input of design innovation. It is suggested that the government adopt new procurement laws specifically authorizing the DB delivery method.

Negative attitudes of the owner

Although more and more owners have recognized the effectiveness of the DB system, many of them—especially the owners of public sector—have no strong incentives to adopt this new alternative. This is mainly because, firstly, most of the owners have got

used to the traditional delivery system, which has been most widely used in the PRC construction market. Secondly, many owners in government-invested projects have no responsibility for the overruns of budgets and construction time. As a result, the public owners take less interest in adopting the DB system despite its obvious advantages and strong promotion from the central government.

Many owners are reluctant to leave the whole project to the design-builder in one single-point contract. They may have the concern that their interests may not be well protected if the projects are under control of the design-builders. In addition, in order to guarantee the success of DB projects, the owners are required to have a clear project definition or ender-user's requirements before it is submitted to the design-builder. This poses challenge to many owners. It is also more difficult for the owner to select the appropriate contractor and collaborate with the design-builder in DB projects. The new requirements for the owners may discourage them to attempt the DB system. It will take time for the owner to fully accept this new system in the PRC construction market.

High requirement of the DB projects

The execution of the design-build system is quite different from the traditional way. As the design-builder assumes the total responsibility for a DB project, he should possess the ablity to fully combine the design and constructin functions and coordinate various building professionals. Many contractors lack these skills in the current PRC construction market. In the DB process, most of the construction work starts before the total completion the shop drawings, thus cause large fluctuation in the labor force and material supply. It will, in turn, not only require huge capital scale of the DB contractors

but also incur higher risk to the design-builders because most of the DB contracts are awarded on a lump-sum basis. In addition, the DB contractors have to take charge of the subcontract management that will increase the financial cost and administrative burden.

The higher bidding cost is another obstacle to the contractors. Many of the DB projects have large scales and require better constructablity of the design work. DB contractors thus have to spend large sum of money and resources for the bidding process. The cost estimation for a DB project is very difficult because the design documents are often preliminary and may change over the course of the project. Estimates should be accurate, and reasonably verifiable in order to minimize risk. Only the bigger companies with diverse skills and resources can afford the high bidding cost and set up the estimation/bidding system for the DB contract.

CONCLUSION AND FUTURE WORK

The central government has been promoting the DB system strongly in recent years. The development of this method however, is still at its infancy stage. It is therefore necessary to firstly investigate the suitability of DB system in the PRC construction market. The results suggest that the DB system will bring benefits to the PRC construction industry. The DB advantages such as single-point responsibility, shortening duration time, fixed budget and schedule can theoretically provide solutions to many problems, which now exist in the construction market of the PRC. It is believed that the DB market will have much larger capacity in the future.

After the investigation of the DB market, this paper focuses on exploring promising factors attributing to the fact that the DB system is not yet popular whilst in theory it should be beneficial. The findings suggest that unlike the construction industry in general, the DB market is characterized by high barriers to entry. These barriers mainly relate to the existing legal system, the owner's attitudes and the requirements of DB projects. The central and local governments, the owners, and the DB contractors should collaborate together to overcome these barriers. The contractors are especially required to improve their abilities such as the financial capability, the design & construction expertise, and the enterprise scale.

Although the identified factors all constitute barriers to entry, they differ in different industries in the DB market. It is necessary to investigate the DB system and barriers to entry in different industries respectively in the future research work. In addition, the identified barriers to entry will have different effects on different contractors. The contractors can choose to be an integrated design-builder, a joint-venture partner, or a subcontractor in the DB market. Therefore, how the current DB market affects the contractors should be also studied in the future research work.

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Table1: The added value of the construction industry from year 2000 to 2006

Year	Construction industry (Billion USD)	Growth (%)	The percentage in GDP (%)
2000	66.86	6.8	5.6
2001	71.81	7.4	5.4
2002	78.11	9.0	5.4
2003	90.50	15.9	5.5
2004	105.04	16.1	5.4
2005	123.73	16.6	5.5
2006	151.74	16.9	5.6

Source: National Bureau of Statistics of China. Statistical Yearbook 2007

Table2 DB contract values of the top 60 contractors & top 100 design consultants, 2003-2005

Year	DB contract value of the top100 design consultants (Billion USD)	DB contract value of the top 60 contractors (Billion USD)	The sum of the total value (Billion USD)	The total output of construction industry (Billion USD)	The ratio (%)
2003	4.55	6.6	11.2	278.9	4.0
2004	6.57	8.5	15.1	350.6	4.3
2005	9.40	10.4	19.8	421.9	4.7

Source: China Exploration & Design Association and *Engineering News Record & Construction Times (2003-2005)*

Table 3 The DB contract values in different industries (top 5) (million USD)

INDUSTRY	2002	2003	2004
Metallurgic	544.5	1213.2	1716.7
Petrochemical	1128.1	975.2	1452.8
Electronic	552.6	583.2	879.5
Chemical	329.1	384.2	573.0
Building material	215.2	336.6	348.2
∑sum above	2769.5	3492.4	4970.3
The ratio	75.0 %	76.2 %	75.5 %

Source: China Exploration & Design Association (2002-2004)

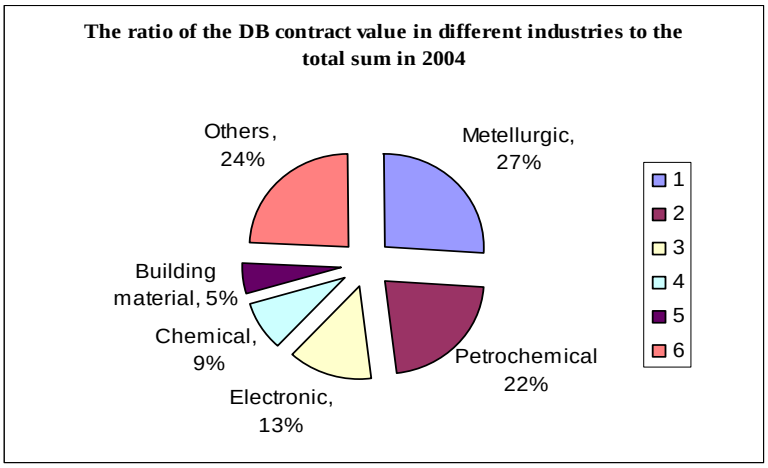

Fig1 The ratio of the DB contract value in different industries in 2004

(Source: China Exploration & Design Association, 2004)

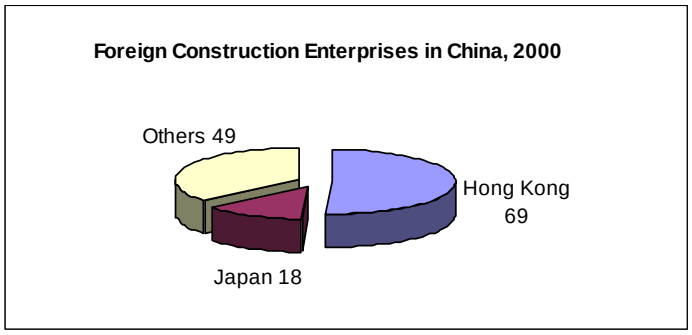

Fig2 The numbers of foreign construction enterprises in China in year 2000

(Source: Ministry of Construction of the People's Republic of China, 2000)

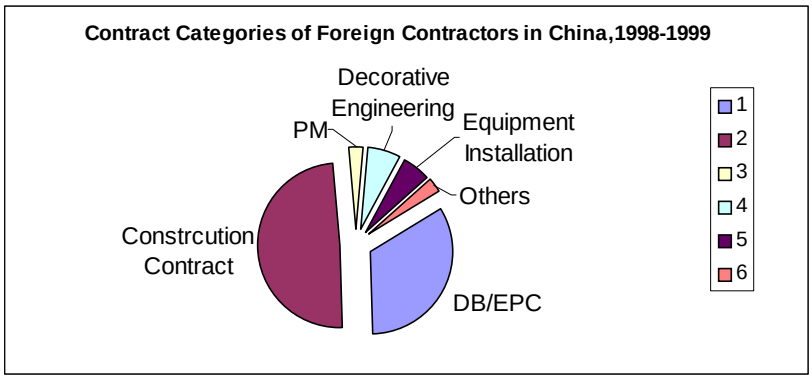

Fig 3 Contract categories of foreign contractors in China from 1998-1999

(Source: Ministry of Construction of the People's Republic of China, 2000)